(*Camelina sativa*) as a single example of agricultural produce. "The cultivation of this plant for the seed would repay the farmer; an abundance of chaff would be produced which would be of infinite service for horses or for manure. In a grazing country like England, where vast sums are annually expended for foreign oil-cake, the Gold of Pleasure will soon be found an excellent substitute under manufacture, and, consequently, a grower should find a good remuneration in cultivating the seed. The oil-cake has been found highly nutritious in the fattening of sheep and oxen, as it contains a great portion of mucilage and nitrogenous matter, which combined are found very beneficial in developing fat and lean." The prospects of making this a most important agricultural plant are, we think, too brightly drawn, considering that it has not escaped the notice of English agriculturists. Nevertheless, a few words of this kind on different products might help to promote experiments on their culture and utility. The writer's aim throughout seems to be a general utilisation of vegetable productions, and he very ingeniously finds a variety of application for those of the Southern States. We do not hesitate to say that a few books of this description on the economic products of different parts of the globe, would make us much better acquainted with the true value of the vegetable kingdom than we are at present.

JOHN R. JACKSON

Adventures of a Young Naturalist. By Lucien Biart. Edited and adapted by Parker Gillmore. (London: S. Low, Son, and Marston, 1870.)

THIS is a narrative of travel in Mexico, intended especially for young people interested in Natural History. The party consists of a young lad the hero, his father, a Swiss naturalist who does all the moralising, a dog, and one of those half-bred Indians who know everything and can do everything, who are such a bore in most books of Western travel. Though written in a somewhat pedantic style, we have no doubt it will find many admirers among our adventure-loving young readers, the country described being one of unsurpassed beauty and interest. For our own part, we should decidedly object to being cross-examined in the following manner before being allowed to eat our breakfast. "Do you know the family of the animal we are going to have for breakfast?" asked Sumichrast. "Yes; it is a Rodent." "Well done; but how did you recognise it to be so?" "By the absence of canine teeth in its jaws, its large incisors, and its hind-legs being longer than its fore-legs." Especially if the lesson were given in such a confused style as this:—'The bird belongs to the family of Climbers, that is to say, to that order which have two toes in front of their claws and two behind, like your great friends the parrots." Still the young naturalist will find in the book much that is interesting and amusing; and the numerous illustrations and gorgeous binding will make it an acceptable present during the Christmas season.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Contribution to the Dioptrics of Vision

IN the course of some experiments in reference to vision under water, I have ascertained some facts which I do not remember to have seen mentioned by writers on optics, and which may perhaps interest your readers.

Every swimmer knows that, however clear the water may be, and however distinctly he may see from the bank the smallest particle of gravel or weed, the moment he plunges beneath the water all becomes obscure, and he can see the outline of nothing at the bottom or suspended in the water distinctly, but only blurred patches of various colours. In my first endeavours to find a remedy for this imperfect vision, I found two ways of restoring perfect sight. The one was to surround the eye with a watertight box, with a piece of plain glass in front. By this means, the eye being in the same condition as to receiving the rays of light through an aërial medium as when we are on land, perfect vision is retained beneath the water. The other was, allowing the eye to remain exposed to the water, to look through a glass lens whose proper focal distance in the air, I found, after numerous trials, to be half an inch. The first method is attended by the disadvantages that the glass soon becomes dim from the condensation of vapour, and it is difficult to make it fit so accurately as to exclude the water; the second is more convenient, as any optician can construct a pair of spectacles suitable for the water, and fitted with lenses of the required focal distance.

Fishes, cetaceous animals, and seals, see perfectly below the water, while man's vision, unassisted, is of the most imperfect character. The eyes of these marine animals differ from those of terrestrial vertebrates chiefly in this: the latter have a very convex cornea, with a large chamber containing aqueous humour and a double convex lens behind; whereas the former have a flat cornea, hardly any aqueous humour, and a spherical lens, lying, at least in fishes, close behind the transparent membrane which is their substitute for a cornea.

Now, as an optical instrument, the eye of terrestrial vertebrates—and let us take that of man for an illustration—consists of two lenses, one placed behind the other. The anterior lens is formed by the aqueous humour, its actual figure being a meniscus, one surface being convex the other concave, but both surfaces uniting if prolonged. According to Donders, the anterior radius of curvature, formed by the cornea, is 8 mm., the posterior, formed by the front of the crystalline, being 10 mm. The posterior lens is the crystalline, a double convex lens, its posterior surface, according to the same authority, having a radius of 6 mm. only. The combination of meniscus and double convex lens is known to possess peculiar optical advantages. The vitreous humour cannot act as a convex lens, its form being that of the concavo-convex lens, whose property is to cause divergence of rays of light; but, as it lies in contact with the retina, it cannot even produce this effect. It acts, together with the aqueous humour, as a watery medium for the suspension of the crystalline.

What happens when the human eye is immersed in water? A transparent lens-shaped body will refract the light in converging rays, if it is much denser than the surrounding medium through which the rays of light reach it. A simple experiment will prove this. Take two watch-glasses with their concavities facing one another; fill the space between them with water; this will form in air, than which it is so much denser, a lens of power proportioned to the convexity, but in water it will not refract the light at all, being of the same density as the light-conducting medium. The aqueous humour of the eye being much denser than the air, acts as a lens in the atmosphere, but being of the same density as water, when the light is transmitted to it through water in contact with the eye, we at once lose the use of our anterior lens, and can see nothing distinctly; because the crystalline, which alone now acts as a lens, throws its focus, as we shall presently see, beyond the retina.

How, then, are we to recover perfect vision under water? Obviously, by supplying the loss of our anterior lens by another lens of equal power. The focal distance in the air of a water lens of the meniscus shape and the dimensions given above may be calculated; it is, in fact, two inches or thereabouts; but, as we have seen, it = 0 in water. But, as the refractive power of a lens diminishes in proportion as that of the medium through which it receives rays of light increases, we find that a glass lens when immersed in water has only one-fourth of the refractive power it possesses in air. So, in order to supply the loss of our anterior lens, we find we must use a glass lens of about half an inch focus, which, in water, has a focus of about two inches. I need scarcely say, that in the case of a double convex lens of dissimilar curves it makes a great difference as regards the refractive power whether the lens be wholly immersed in water or one or other of the convex surfaces only. But I need not dwell on this subject at present.

But it is a clumsy method to supply the loss of a lens of two inches focus by one of the high refracting power of half an inch. Besides, a glass lens of this power is so small that the lateral field of vision is of necessity very limited, and it has a further disadvantage that we can see nothing with it in the air. I therefore sought for a lens that should be free from these defects.

As the ocular lens whose place had to be supplied is formed

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of water, and receives in the normal condition the rays of light through air, I thought I might make my subaqueous lens of the same media. A couple of watch-glasses, placed with their concavities towards one another, so as to enclose a convex lenticular portion of air, when immersed in water, disperse the rays of light and diminish the size of objects seen through them, because they force the more refractive medium, the water, to assume a *concave* shape in relation to the air between the glasses. The same watch-glasses placed with their convex surfaces towards one-another, and connected round their edges by a water-tight rim, thus enclosing a concave lenticular portion of air, when immersed in water, refract the rays of light convergently to a focus and magnify objects, because they force the more refractive medium to assume a *convex* shape in relation to the air between the glasses. Their magnifying power or focal distance under water is somewhat less than that of the same glasses in the reversed position and filled with water is in air; the slight difference being owing to the greater refractive power of the glass in air than in water. I found that two glasses of a curvature of about $1\frac{1}{4}$ inch radius thus placed formed in water a lens having a focus of about two inches. This *air-lens*, as it may be called, completely supplies the loss of our anterior lens in water, and restores perfect vision. Of course the same magnifying power may be obtained by various combinations of differently curved glasses, or by plano-concave or concavo-convex air-lenses. The advantages of this kind of lens for subaqueous vision over a glass lens are obvious. It can be made of any required size so as to command a large lateral field of vision. It ceases to act as a lens the instant it emerges from the water, and does not interfere with vision in the air, as then we merely look through two thin pieces of glass with some air between them. There is no provoking loss of refractive power, as in the case of the glass lens; and lastly, it can be made very cheaply. With either form of lens we can see from below the water objects in the air above us quite distinctly if the surface of the water is smooth, less distinctly if it is agitated.

Air lenses constructed on the principle described may be made of any magnifying power, and are much better adapted for the microscopic examination of objects under water than glass lenses, whose refracting and magnifying power is reduced to one-fourth by immersion. Thus a glass lens of a quarter-inch focus in air, would scarcely be equal in water to an air lens of one inch focus.

I have said that the difference between the refractive power of a glass lens in air and water is as 4 to 1, or even more. The difference is about the same in the case of the crystalline. Thus, the spherical lens of a cod, which has a focus of about $\frac{3}{20}$ of an inch in air, has a focus of about $\frac{3}{5}$ of an inch in water, which is about the distance of its posterior surface from the retina in the fish. Supposing the focal distance of the human crystalline to be, in air, $\frac{1}{6}$ of an inch, it will be more than $\frac{2}{3}$ of an inch in the fluid in which it floats. But, in front of it, we find what I have called the anterior lens—I mean the aqueous humour—with a focus, as I have proved, of about 2 inches. If we take two lenses respectively of 2 inches and $\frac{2}{3}$ of an inch focus, and place the weaker over the stronger, we shall find their united focal distance to be about $\frac{1}{2}$ an inch, or about the distance between the back of the human crystalline and the retina. My measurements, in the absence of appropriate instruments, lay no claim to exactness; they are, however, a sufficient approximation to truth for my present purpose.

How is it that after the operation of extraction of the crystalline lens, which has a focus of less than 1 inch in its natural position, the patient can see distinctly with a lens of from 3 to 4 inches focus? The reason seems to be that the optical character of the eye is completely altered by the operation. The space formerly occupied by the crystalline is now filled with aqueous and vitreous humour, and the eye represents a sphere of water, bulging in front into a more convex form by means of the cornea, which will have the effect of a superimposed meniscus of about 2 or $2\frac{1}{2}$ inches focus. A thin glass sphere filled with water of 1 inch diameter will roughly represent the eye deprived of its crystalline. We find the focus of this sphere to be about $\frac{1}{2}$ an inch. Let us place in front of it a lens of $2\frac{1}{2}$ inches focus to represent the bulging cornea, and we find the focal distance diminished by more than one-half. Another lens of 3 to 4 inches focus will bring this focus close to the posterior surface of the sphere, in fact, to the situation of the retina in the actual eye. This explains what happens in the eye deprived of its crystalline. Such an eye will require a much more powerful lens for subaqueous vision than that above described.

Montagu Square R. E. DUDGEON, M.D.

Dr. Lankester and the Scarlet Fever Epidemic

PERMIT me to make a few remarks on some notices of my paper on scarlet fever, published in your pages on the 17th of November last. Referring to my recommendation as to the destruction of the poison of scarlet fever, the *Pall Mall Gazette* says—"All this is very well in its way, and may be carried out by the upper and middle classes, among whom the mortality from scarlet fever is comparatively small; but the plan is quite out of the reach of poor creatures who have but one room, one bed, and one suit of clothing, which even at night takes the place of blankets." My object in writing the paper was to show that scarlet fever might be averted by certain measures, and I left it to those who read it to devise the means of making them available for all. When the cattle disease broke out, an Act of Parliament was passed for the purpose of diverting it. The lives of human beings are surely of not less value even in a money point of view than those of cows and oxen, and I have the conviction that certain measures might be adopted by the Government that would reach even the "poor creatures" to whom the *Pall Mall Gazette* alludes. Even now there exist Acts of Parliament which, if at once put in force by boards of guardians, town councils, vestries, and other local authorities, would at once enable them to put down this disease. The inhabitants in "one room, one bed, and one suit of clothing," are reached by medical men, and they might be empowered to remove the sick from the healthy, to destroy useless infected clothing, to have the infected linen washed, and generally to see that the disease is arrested. What can be done amongst the rich ought to be done amongst the poor, and expense ought not to be allowed to stand in the way of such merciful measures. It should be remembered that such outlay on the part of wealthy ratepayers would, in the end, repay them, as they catch this disease from its being fomented among the poor, and they would no longer be liable to these attacks when their less opulent neighbours were free from them.

In the pages of the *Lancet* "A General Practitioner" states that I have reflected on the members of the medical profession in stating that they do not exert themselves to suppress this disease. I spoke from a rather extensive experience on this subject, and regret to say that I have nothing to withdraw on this point. I did not say it was the fault of medical men. I said they were not instructed. This is the fault of a system of medical education in which public health is not contemplated as a part of its course. It is true that within the last two or three years chairs of Hygiene have been established at University and King's Colleges, London, but these are exceptional. So deficient is the education of medical men on this very point, that the Government felt itself justified in opening a special medical school at Netley for the purpose of supplementing the defects of our ordinary medical schools. It is from the Chair of Hygiene at the Military Hospital that the most admirable work on Hygiene in our language, by Dr. Parks, has issued.

"A General Practitioner" could not suppose that I was ignorant of the fact that all that has been done for our knowledge of the nature of contagious diseases had been done by medical men, and that our medical officers of health have especially exerted themselves in endeavouring to prevent the spread of contagion. I must, however, again express my surprise at the small amount of information that can be gained from the text-books on the practice of medicine as to how best to prevent the spread of contagious diseases.

I will not in your pages do more than allude to the offensive tone and expressions of "A General Practitioner," but I may add that no amount of "support" I may have had or may expect to derive from members of my profession, will ever induce me to refrain from speaking the truth of them in the interests of the public. I am, however, fully convinced that it is only by such a course that I can hope to retain the respect and continued "support" of the more intelligent and honourable members of my profession. EDWIN LANKESTER

Professor Tait on Bain's Logic

IN your last week's number, Prof. Tait publishes a portion of his Introductory Lecture to his class, in which he criticises certain passages in my work on Logic, having reference to the doctrine of the Conservation of Force. Although I do not, in every instance, admit the justice of the strong condemnatory phrases used in the criticism, I am aware of having committed

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